PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B29C 49/22

A1

(11) International Publication Number: WO 91/08099

(43) International Publication Date: 13 June 1991 (13.06.91)

(21) International Application Number: PCT/GB90/01812

(22) International Filing Date: 23 November 1990 (23.11.90)

(30) Priority data:
8926490.7 23 November 1989 (23.11.89) GB
9005879.9 15 March 1990 (15.03.90) GB

(71) Applicant *(for all designated States except US):* LIN PAC PLASTICS INTERNATIONAL LIMITED [GB/GB]; Charles Street, Louth, Lincolnshire LN11 0LA (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : BUTTERWORTH, James [GB/GB]; 7 St. James Mount, The Mount, York YO2 1EL (GB).

(74) Agent: GILL JENNINGS & EVERY; 53/64 Chancery Lane, London WC2A 1HN (GB).

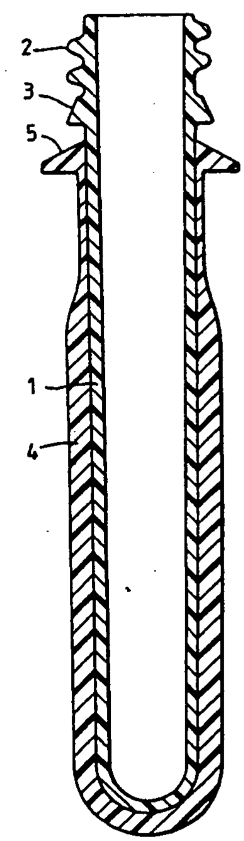
(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: BLOW MOULDED CONTAINERS

(57) Abstract

A preform for a blown container is injection moulded as two separate pieces (1, 4) which are subsequently fitted together before the preform is blown to form the container. Preferably the two separate pieces (1, 4) of the preform comprise an inner part (1) and an outer part (4) with both the inner and the outer part extending over the whole of the part of the preform which is used to form the body of the container. By making the preform from two separate pieces (1, 4) an increase in both strength and impermeability is obtained. It is also considerably more efficient and provides much greater flexibility when including additional layers (6, 18).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	ML	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NL	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	SD	Sudan
CF	Central African Republic	KP	Democratic People's Republic of Korea	SE	Sweden
CG	Congo			SN	Senegal
CH	Switzerland	KR	Republic of Korea	SU	Soviet Union
CI	Côte d'Ivoire	LI	Liechtenstein	TD	Chad
CM	Cameroon	LK	Sri Lanka	TG	Togo
DE	Germany	LU	Luxembourg	US	United States of America
DK	Denmark	MC	Monaco		
ES	Spain	MG	Madagascar		

Blow Moulded Containers

Blow moulded bottles especially those made of clear plastics material which is bi-axially oriented during its blow moulding step are nowadays very popular. They are usually made entirely from or at least include PET (polyethylene terephthalate). Such bottles are used to contain both carbonated and non-carbonated liquids. When they are used to contain carbonated liquids they often have domed ends to help resist the internal pressure. To enable such bottles to stand, the domed bottom end is fixed into a separate base cup and the resulting bottles are referred to as two-piece bottles. Blow moulded bottles are usually disposable and intended to be used once only. However since PET is expensive it is desirable, at least, to recycle the plastics material. This means that two-piece bottles are not preferred since the base cups are usually made from cheaper plastics material than PET which is not miscible with PET and hence the bottle as a whole is not recyclable. One-piece bottles are also known in which the domed base includes projecting feet and these do not suffer from this disadvantage. Also attempts have been made recently to provide PET bottles that are re-usable. Such bottles have a much greater wall thickness to withstand the subsequent cleaning and re-sterilizing processes.

To manufacture a blow moulded bottle firstly a preform or parison is made by injection moulding or by forming an extrusion which is subsequently placed in a mould. The preform includes a moulded neck support ring, a sealing surface for the closure, and a closure attachment such as an external screw thread or an external ring around the neck of the bottle. The preform is then preheated, or at least temperature conditioned if it has only just been formed, and is blown in a conventional blow moulding machine. Usually the blow moulding machine includes a stretch rod to extend the preform substantially to its

maximum extent before or whilst the preform is inflated into a female mould.

During its inflation the plastics material in the side wall of the preform which will form the side wall of the bottle is bi-axially oriented which increases its strength and decreases its permeability to a great extent. However, the material forming the neck portion of the bottle and that forming the middle of the base of the bottle are not stretched and accordingly the material in these portions remains as amorphous plastics material and is not bi-axially oriented to any great extent. The neck portion of the bottle is of thick cross-section particularly because of the formation of the closure attachment and the neck support ring whilst the base of the bottle is somewhat thinner. Accordingly it is usually the base of such bottles which is their weakest point. This is especially true when the bottle is formed as a one-piece bottle where considerable creep and deformation of the base may occur after carbonation.

PET has a relatively low permeability which both prevents carbon dioxide escaping from carbonated beverages and prevents the ingress of oxygen into the bottles which can result in oxidation and spoilage of their contents. Where the contents to be packed in the bottles are particularly sensitive to oxygen permeation or where it is required for the contents to have a particularly long shelf life it is often desirable to reduce the permeability of the bottle still further by including some form of barrier layer having a very low permeability. At present, this may be introduced when the preform is made by extrusion, by coextruding a barrier layer concentrically between inner and outer layers of PET. To ensure that no delamination takes place, adhesive is often extruded on both sides of the barrier layer. This technique is complicated and requires very expensive equipment. Furthermore, this technique does not result in a continuous barrier layer

since the barrier material is absent from the base of the resulting bottle.

When injection moulding a preform it is possible to co-inject barrier material with, for example, PET in much the same way as when co-extrusion techniques are used. In this way, as the plastics material is introduced into the injection mould a layer of barrier material is interposed between an inner and outer layer of PET.

To be able to co-injection mould or co-extrude a barrier material it is necessary to use a modified grade of the barrier material to ensure that it has similar viscosity and flow characteristics to that of PET and this somewhat degrades the performance of the barrier material. In general such barrier materials are very expensive and typically many times more expensive than PET. Using techniques such as co-extrusion or co-injection, the barrier material is located in a layer throughout the entire preform and is provided in, for example, the neck region as well as the side walls. In general it is not necessary to include a barrier region in the thick neck region of the finished bottle and thus the expensive barrier material in this region is wasted which leads to the overall cost of the bottle being unnecessarily increased.

It is also known to use insert moulding techniques to produce multi-layer preforms and to mould reinforcing inserts into an injection moulded preform to, for example, reinforce and stabilise the neck portion of a bottle.

According to this invention a preform for a blown container is injection moulded as two separate pieces which are subsequently fitted together before the preform is blown to form the container.

Preferably the two separate pieces of the preform which are fitted together before the bottle is blown comprise an inner part and an outer part with both the inner and the outer part extending over the whole of the

part of the preform which is used to form the body of the container.

By making the preform from two separate pieces an increase in both strength and impermeability is obtained. It is believed that this comes about simply by each piece, on subsequent blowing, being stretched further resulting in a more complete bi-axial orientation of each part of the preform. Also it is believed that the bi-axial orientation of the material resulting from each separate piece has different axes which further strengthens the resulting laminated structure. The side wall of the bottle also contains two additional interfaces between the two separate pieces of the preform which result in a greater tortuous path for oxygen and carbon dioxide molecules as they permeate through the side wall of the container. Thus, by simply making the preform in two separate parts, although the total weight of plastics material contained in the preform is the same, a considerable increase in strength and reduction in permeability is achieved.

This is not the only advantage that is gained by making the preform from two separate pieces. A conventional preform has a wall thickness of typically 2 to 3mm. When producing such preforms by injection moulding the injection moulding machine typically has a cycle time of around 18 to 24 seconds. However, increasing the wall thickness of the preform results in an exponential increase in the cycle time of the injection moulding machine. The plastics material is injected into a preform mould of an injection moulding machine at high temperature in a molten state and must be cooled so that the preform is self supporting before it can be demoulded. With the recent attempts that have been made to provide reusable PET bottles the PET bottles have been made with a very much greater wall thickness and this has necessitated the use of a preform with a wall thickness of around 7mm along with the development of special PET materials, injection equipment and moulds which are suitable for use at this

thickness. Injection moulding such preforms requires a cycle time of around a minute. Such a large increase in the cycle time of the injection moulding machine results in a serious decrease in its capacity and throughput. By manufacturing a thick preform from two, or more, separate pieces the cycle time required to injection mould a thick preform can be considerably reduced. For example, if a preform having a wall thickness of 7mm is, instead of being injected as a single piece, injected as two separate pieces which are subsequently fitted together the total cycle time for the two separate pieces added together is likely to be around 40 seconds in contrast to the cycle time for a single piece preform of around a minute. Thus, the production capacity can be effectively increased by 50% so reducing the injection moulding capacity requirements, allowing the use of conventional injection moulding machines, moulds, and conventional PET materials and thus leading to a saving in capital and materials cost.

The figures quoted above are for a 1.5 litre container. At present, using single part preforms it is totally uneconomic to consider manufacturing returnable containers of any greater volume since the wall thickness of the preform would be so great as to extend the cycle time of the injection moulding machine to an unacceptable degree. However, by making the preform in two or more separate parts it is possible to manufacture thick walled bottles of 2 and even 3 litres capacity. Such bottles require preforms of a thickness around 7.5 mm and 9.0 mm, respectively.

In manufacturing plastics bottles the exact size and weight of the injected moulded preforms used for different bottles must also vary. The size and shape of the preform varies with the shape, capacity and strength requirements of the finished bottle. To produce these different injection moulded preforms conventionally requires a different injection moulding tool for each different preform. Such injection moulding tools are very expensive

and as an example of this a forty eight cavity tool at present costs around £400,000. Small variations in weight of around 2 or 3 grams in a typical conventional preform of weight 48 grams can be achieved by exchanging the core pins of the injection moulding tool. The cost of replacement core pins is much less, typically £20,000 but can achieve only a small weight change. The most expensive part of an injection mould tool is the part containing the lip cavities which form the thread and neck finish of the preforms. For plastics bottles to contain carbonated drinks these are usually of a standard configuration and a size of 28 mm or 38 mm diameter.

By using the present invention to form an inner shell with the neck finish and inner sleeve of standard length, size and weight and then providing a variety of outer shells of different weight, different wall thickness and, if required different material distribution such as a thicker base, injection moulding tool costs can be considerably reduced. The outer shell for the same length preform always has the same length and inner profile to match that of the inner shell. Such outer shells can be made using a mould having a higher number of cavities and lower cost construction to manufacture a range of outer shells. The weight and configuration of the outer shells can be changed by having the mould tool for the outer shell formed with replaceable inserts to define the outer wall of the mould but standard or common core pins. By replacing one set of inserts by another a range of preforms varying in weight from 40 to 60 grams can be manufactured in the same pair of injection mould tools, one for the inner shell and the other for the outer shell. In this way preforms for bottles of capacity 1.5 litre and 3 litres can all be made from this single pair of injection mould tools having only a single set of lip cavities instead of, as at present, requiring the use of three completely separate injection mould tools each with their own lip cavities. This results in a considerable capital cost saving.

To improve the impermeability or strength of the container still further preferably an additional layer is included between the inner and outer parts of the preform. This additional layer may be provided by coating at least one of the adjacent surfaces of the inner and outer parts of the preform with an additional material or, by including a third injection moulded part so that the preform is made of three separate pieces which fit together with the piece to form the additional layer being sandwiched between the inner and outer parts of the preform. The additional layer may be formed as a cap or sleeve which is placed around the outside of the inner part of the preform and which is sandwiched between the inner and outer parts of the preform. The cap or sleeve may be provided from sheet material thermoformed to the appropriate shape or by merely wrapping a piece of flat sheet material which may or may not be fixed to itself around the outside of the inner part. Alternatively the additional layer may be formed by a tube and in this case preferably one end is sealed. In any event the material to form the additional layer is placed on the outside of the inner part of the preform and is sandwiched between the inner and outer parts of the preform.

Another way in which the additional layer can be provided between the inner and outer parts of the preform is by introducing the additional layer initially in the form of a liquid. In this case, whilst the liquid can be coated on the inside of the outer part or the outside of the inner part, preferably a metered quantity is introduced into the inside of the outer part and then the inner part is inserted into the outer part and, in so doing, forces the metered quantity of liquid to fill the entire space between the inner and outer parts and so removes any air from between them.

The use of a liquid also acts as a lubricant when assembling the inner and outer parts. When the additional layer is provided as a liquid the liquid may be a monomer

or co-monomer and subsequently be polymerised after the inner and outer parts have been fitted together. The liquid material may be polymerised at normal room temperature or by the application of heat, for example by radiation, or by excitation by ultra sonic waves. Alternatively the inner shell maybe coated with a catalyst which activates a polymerising reaction on contact with the monomer or co-monomer in the outer part. Alternatively the heat used during the subsequent blow moulding process maybe used to complete the polymerisation.

When it is required to improve the impermeability of the container the additional layer preferably has the form of a layer of relatively impermeable barrier material. Typically the barrier material is a plastics material such as nylon, EVOH (ethylene vinyl alcohol) or PVDC (polyvinylidene chloride). In addition to plastics materials the barrier layer can be provided by, for example, a metal such as aluminium. This may be inserted as an aluminium foil or, alternatively aluminium can be evaporated onto the surface of one of the pieces of the preform. Another way in which oxygen can be prevented from attacking the contents of the bottle is for the additional layer to include an oxygen scavenging material. In this case the oxygen scavenging material chemically combines with oxygen molecules permeating through the side wall of the container to capture them and prevent them penetrating the side wall and reaching the contents inside the container.

To improve the strength of the container the material to form the additional layer may be made from a stronger, and therefore usually more expensive, plastics material than the remainder of the preform. Preferred examples of this are engineering plastics such as nylon and polyarylate, but other materials such as ABS (acrylonitrile butadiene styrene) or SAN (styrene acrylonitrile) may be used. Alternatively the additional layer may be made from the same material as the inner and outer part of the

preform but have different characteristics to improve its strength. As an example of this the additional layer may be made from a bi-axially oriented plastics material such as PET or polystyrene and because the plastics material is bi-axially oriented before the bottle is blown this provides additional reinforcement especially in areas of the preform such as those which provide the base of the bottle where the material from the inner and outer parts of the preform is not bi-axially oriented during blowing but, remains in its amorphous state. Of course, in addition, the bi-axially oriented material used for such a reinforcing layer may be different from that used for the inner and outer parts of the preform.

Preferably the material to form the additional layer is located only in those regions of the preform in which it is required. Thus, when the material has the form of a barrier material it is preferably located only between those parts of the preform that, after blowing, form the body of the container. Thus the high quality and expensive barrier material is not present in the relatively thick neck region of the container and this leads to a considerable saving in the use of the barrier material. Equally, when the material to form the additional layer provides a physical reinforcement of the bottle this additional material may be provided only in the regions where it is needed. Thus, for example, if it is required to reinforce the base of a bottle which is to contain a carbonated beverage, the reinforcement has the form of a cap or thimble which is thermoformed from bi-axially oriented materials so that, after blowing, it is located only in the region of the base of the container. This ensures that the entire body region of the container then contains bi-axially oriented material and this prevents the conventional stress cracking which occurs in the base of the container and improves the impermeability of the base region of the container. Such reinforcement enables the overall weight of the plastics material used for a

particular container to be reduced. In another example reinforcement can be provided in the form of a number of strips or hoops around the side wall of a cylindrical bottle by providing separate strips or bands of reinforcing material between the inner and outer parts of the preform.

The two or more separate pieces which fit together to make the preform preferably include attachment means which positively connect together the two or more separate pieces. The attachment means may have the form of a mechanical lock which is provided by, for example, interengaging formations on the various separate pieces which, for example, snap together upon assembly of the preform. Alternatively, the mechanical lock may be provided by a taper fit between the various pieces of the preform or be formed by welding together the various pieces of the preform. The welding may have the form of a small ultrasonic spot weld or heat fusion.

The attachment means may have the form of an adhesive which is provided on at least one of the adjacent faces of all of the separate pieces of the preform. This is especially preferred when the different parts of the preform are made from different materials to ensure that a good bond takes place between all parts of the preform on heating and before the subsequent blowing of the preform to form a container. An adhesive ensures that the different layers in the finished container provided by the different pieces of the preform do no delaminate and this further increases the strength of the resulting container.

When the adhesive has the form of a liquid it may be coated onto at least one of the adjacent faces of all of the separate pieces of the preform. Preferably, however a quantity of the liquid adhesive is metered into the inside of the outer, or each piece of the preform that has an inner part inserted into it. The adhesive may have the form of a heat sensitive adhesive which cures upon the application of heat but preferably it is formed as a monomer of the same material as at least one of the parts

of the preform and, after the two or more parts of the preform have been coupled together, the monomer is cured by heat, radiation or catalytic action to bond the two parts of the preform together.

When a liquid is included between two adjacent parts of the preform either to act as an adhesive or to act as an additional layer preferably the two adjacent parts of the preform include spacing means extending into the space between the two adjacent parts of the preform. The spacing means may take the form of longitudinally extending ribs or splines and preferably these are tapered in the radial direction. The spacing means ensures that the adjacent parts of the preform remain concentric and that the adhesive or additional layer has a uniform thickness in the circumferential direction around the preform.

As an alternative the two or more separate pieces of the preform, even if mechanically locked together, can be arranged positively not to adhere to one another even after they have been blown. For example, the adjacent surfaces of the parts of the preform may be coated with talc or be provided with an alternative non-stick coating such as PTFE (polytetrafluroethylene) or a mould release agent.

In this case preferably vents are provided between the two parts of the preform. When the container is blown from such a preform provided it is inflated only by the introduction of gas into the inside of the inner part of the preform it forms a container in a conventional fashion. However, after use of such a container the inner layer of the container, since it is not bonded to the outer layer, can be removed by, for example, applying a vacuum to the inner part of the container and allowing air to flow through the vents into the interface between the two parts. This enables the container to be re-cycled when made from two different materials or by subsequently using the outer part of the container as a mould and blowing a new inner part of the preform into the outer container. In this

latter case the vent between the two parts allows the inner part to be blown. In this way a refillable bottle system is provided which is absolutely safe, does not require any washing step and is completely recyclable. It is only the inner part of the preform and resulting bottle which contacts the liquid and it is this part which is removable and subsequently can be replaced by a brand new freshly blown, sterile and clean inner part of the container before the outer part of the container is reused. In this case the material distribution between the outer part of the preform and inner part of the preform is arranged so that the majority of the material is contained in the outer part of the preform with only a very light weight and small amount such as 10% of plastics material is used in the inner part of the preform which acts as a lining. Even the inner part of the container can be reused by recycling its material to produce new outer parts of preforms. Thus, in spite of having a replaceable lining the container is 100% recyclable.

The present invention is particularly useful when the container is formed with a reduced diameter neck and thus has the form of a bottle. However, the invention is also applicable to containers formed as tall or shallow wide-mouthed jars, for example.

Typically the material used with the present invention to form the inner and outer parts of the preform is the same and is usually PET. One useful way of using the present invention is to make the inner part of the preform from virgin plastics material and the outer part from recycled plastics material. In this way, even if the recycled plastics material is contaminated in some way since the inner part of the preform, which forms the part of the blown container which contacts the contents of the container, is made from virgin plastics material, the resulting container is still completely safe to use, even for foodstuffs. The present invention can also be used with polystyrene and polypropylene.

Different materials may be used for the inner and outer parts of the preform and this arrangement enables particular requirements to be met easily. For example, PET has a glass transition temperature of around 70-75° centigrade in its amorphous state which increases to 160-180° centigrade when it is bi-axially oriented. Since it has such a low glass transition temperature the parts of the PET bottle which are still in their amorphous state soften and deform when such a bottle is filled by liquid which has just been flash pasteurised at 90C immediately before filling or, distort and deform if the bottle and its contents are subjected to a postfilling pasteurisation process. Other materials, such as polypropylene and most of the engineering plastics referred to earlier are much more temperature stable. Accordingly, it is possible to make the inner or outer part of the preform from a temperature stable plastics and the other from, for example, PET to provide a composite which has both a high degree of temperature stability and the good barrier properties such as resistance to permeability by water vapour that are required.

Where the two separate pieces of the preform which are fitted together before the bottle is blown do not comprise an inner and an outer part extending over the whole of the part of the preform which is used to form the body of the container they may, instead, comprise one part which forms a basic preform and parts of which are present in the wall of the entire container and a second part which is restricted to a particular localised extent in the complete container. Thus, in this way, the second part may provide localised reinforcement by providing, for example, a ring of a dimensionally stable plastics material which is used to define the inside of the neck of a container with the remainder of the preform being formed of less stable material. As an example of this the inside of the neck of a preform which, in turn, provides the inside of the neck of the finished container and against which an internal

plug on the closure forms a seal, may be formed from a dimensionally and thermally stable plastics material such as polyarylate or an engineering plastic whilst the remainder of the preform is formed of, for example, PET. Another way in which this aspect of the invention can be used takes account of the fact that PET itself is a reasonably expensive material and so provides a way of using a cheaper bulk material to provide the thicker regions of a bottle whilst allowing only PET to be used to provide the side wall of the body of the container. In this way, again taking the neck of the preform as an example since this portion of the final bottle has the greatest thickness and hence uses the largest quantity of PET, it is possible to use a cheaper material for this thick section of the preform and to use the other material for the remainder of the preform. Thus, the neck support ring and the closure attachment may be formed by a relatively cheap plastics material such as PVC whilst the entire inner surface of the neck region and the main body of the preform can be formed by a more expensive material such as PET.

Various examples of preforms in accordance with this invention will be described briefly in the accompanying drawings in which:-

Figures 1 to 6 are all longitudinal sections through different examples of preforms;

Figure 7 is a cross-section through a mould for manufacturing the outer part of a preform;

Figure 8 is a radial longitudinal section through the core pin of a modified form of mould;

Figure 9 is a cross-section through another example of preform made using the mould shown in Figure 8; and,

Figure 10 is a scrap cross-section drawn to a very much larger scale of part of Figure 9.

A first example of preform in accordance with this invention which is shown in Figure 1 comprises an inner shell 1 including a closure retaining male screw thread 2

and tamperproof seal retainer 3, and an outer shell 4 which includes a neck support ring 5. Both the outside of the inner shell 1 and the inside of the outer shell 4 taper towards their closed ends to facilitate insertion of the inner shell 1 into the outer shell 4. An adhesive (not shown) may be provided between the two shells 1 and 4 to ensure that they are bonded together. In this example both shell 1 and shell 4 are made from PET.

A second example of preform shown in Figure 2 is generally similar to that shown in Figure 1 but in this example an additional layer 6 is sandwiched between the inner and outer shells 1 and 4. The additional layer 6 consists of a laminate of heat sensitive adhesive, EVOH, and a heat sensitive adhesive. Preferably the additional layer 6 is initially formed as a co-extruded tube which is cut to length and then one end closed before being pushed onto the outside of the inner shell 1. Also in this example both the inner and outer shells 1 and 4 are made of PET.

Figure 3 shows a third example which is generally similar to Figure 2 but is of larger diameter to provide a bottle of larger size.

Figure 4 shows a fourth example of preform in accordance with this invention for producing a bottle with a relatively thick outer wall and a separate internal liner. In this example the anti-pilfer ring support 3 is formed as part of the outer shell 4 instead as part of the inner shell 1. Again both the inner and outer shells 1 and 4 are formed of PET but the outer shell 4 has a very much greater wall thickness than the inner shell 1. This results in the wall thickness of the finished bottle having a corresponding difference in thickness. The outer shell 4 also includes internal longitudinally extending channels 7 around the inside of its neck which provide venting for the space between the two shells after the bottle has been formed. This allows the liner formed by the inner shell 1 to be collapsed by applying a vacuum to the neck of the

bottle. The resulting bottle may be re-lined before being re-used. When the inner and outer shells are made from different materials the inner shell may be collapsed to allow the inner and outer shells to be separated before material from which they are made is recycled.

In each of the first four examples whilst normally both shells are formed of the same material it is convenient to form the outer shell 4 from recycled PET and the inner shell 1, which in use forms the entire contact surface with the contents to be packaged in the resulting bottle, from virgin plastics material to ensure that it is in no way contaminated.

A fifth example of preform in accordance with this invention is shown in Figure 5. This fifth example is generally similar to the second and third except that the inner shell 1 is formed from polypropylene whilst the additional layer 6 and outer layer 4 are the same as the second and third examples. By forming the inner shell 1, which includes the neck region of the finished bottle, from polypropylene which has a good thermal stability a bottle is formed which can be hot filled with liquid, immediately after it has been flash-pasteurised without distortion of the bottle neck as would happen if the inner shell 1 was made of PET.

A sixth example of preform which is shown in Figure 6 whilst generally similar to all the others and made of the same material as the fifth example has a neck which is very much wider than its conical body. The additional layer 6 is thermoformed into a conical shape before being sandwiched between the inner and outer shells 1 and 4. This example of preform is intended to produce jars which can be hot filled with, for example, baby food or jam.

The shells 1 and 4 are made in a typical injection moulding machine using generally conventional moulds such as shown in Figure 7. Figure 7 illustrates a mould for producing the outer shell 4 of a preform such as that shown in Figure 2. The mould consists of a main female part 10

with channels 11 for cooling fluid such as water, and a hollow core pin 12. The core pin 12 includes a cooling fluid fountain tube 13 to direct cooling fluid towards the base of the hollow core pin 12 and an ejector plate 14 surrounding the outside of the top of the core pin 12. With a core pin 12 inserted into the body portion 10 liquid plastics material is injected from a hot runner via an injection point 15 into a mould cavity formed between the core pin 12 and the mould part 10. As soon as the plastics material has set so as to be self-supporting the core pin 13 is lifted out of the female mould portion 10 carrying with it the outer shell 4. The ejector plate 14 is then moved downwards with respect to the core pin 12 to dislodge the outer shell 4.

A similar mould is used for the inner shell 1 except that this also includes a two-part head portion of the mould to release the screw thread and anti-pilfer ring retainer 3.

A modification of the mould is used when it is required to provide the additional layer 6 between the inner shell 1 and outer shell 4 by using a material which is initially in the liquid state. This additional layer may be used to form a high barrier layer or may be used as an adhesive to adhere the inner and outer shells 1 and 4 together. In this case, to ensure firstly that a gap is left between the inner and outer shells to accommodate the liquid material, and secondly to ensure that this gap is uniform in a radial direction around the preform a number of longitudinally extending grooves 16 triangular in section are cut into the outside of the core pin 12, as shown in Figure 8. This results in the inside surface of the outer shell 4 having a number of triangular section longitudinally extending ribs 17 formed on its inner surface as shown most clearly in Figures 9 and 10. These ribs 17 ensure constant spacing between the inner and outer shells 1 and 4 to provide a substantially constant

thickness of liquid material 18 between the inner and outer shells 1 and 4 to form the additional layer 6.

CLAIMS

1. A preform for a blown container characterised in that it is injection moulded as two separate pieces (1,4) which are subsequently fitted together before the preform is blown to form the container.

2. A preform according to claim 1, in which the two separate pieces (1,4) of the preform which are fitted together before the bottle is blown comprise an inner part (1) and an outer part (4) with both the inner (1) and the outer part (4) extending over the whole of the part of the preform which is used to form the body of the container.

3. A preform according to claim 1 or 2, in which an additional layer (6,18) is included between the inner (1) and outer (4) parts of the preform.

4. A preform according to claim 3, in which the additional layer (6) is formed as a third injection moulded part so that the preform is made of three separate pieces which fit together with the piece (6) to form the additional layer being sandwiched between the inner (1) and outer (4) parts of the preform.

5. A preform according to claim 3, in which the additional layer (18) is provided between the inner (1) and outer (4) parts of the preform by introducing it initially in the form of a liquid.

6. A preform according to claim 5, in which the liquid to form the additional layer is a monomer or co-monomer and is subsequently polymerised after the inner (1) and outer (4) parts have been fitted together.

7. A preform according to any one of claims 3 to 6, in which the additional layer (6,18) is a relatively impermeable barrier material such as nylon, EVOH (ethylene vinyl alcohol), PVDC (polyvinylidene chloride) or aluminium.

8. A preform according to any one of claims 3 to 6, in which the additional layer (6,18) is made from a stronger plastics material than the remainder of the preform (1,4),

examples of such stronger materials are nylon, polyarylate, ABS (acrylonitrile butadiene styrene) or SAN (styrene acrylonitrile).

9. A preform according to claim 3, in which the additional layer (6) is made from the same material as the inner (1) and outer (4) part of the preform but has been conditioned to improve its strength such as by having been bi-axially oriented.

10. A preform according to any one of the preceding claims, in which the two or more separate pieces (1,4,6) which fit together to make the preform include attachment means which positively connect them together.

11. A preform according to claim 10, in which attachment means have the form of a mechanical lock provided by interengaging formations on the various separate pieces which snap together upon assembly of the preform.

12. A preform according to claim 10, in which the attachment means have the form of an adhesive which is provided on at least one of the adjacent faces of all of the separate pieces (1,4,6) of the preform.

13. A preform according to claim 10, in which the attachment means has the form of a liquid adhesive (18) which is cured after the two (1,4) or more (6) separate pieces of the preform are coupled together.

14. A preform according to claim 5, 6 or 13, in which two adjacent parts of the preform (1,4) include spacing means (17) extending into a space between them to ensure that the adjacent parts (1,4) of the preform remain concentric and that the adhesive (18) or additional layer (6) has a uniform thickness in the circumferential direction around the preform.

15. A preform according to any one of claims 1 to 11, in which the two or more separate pieces of the preform are arranged positively not to adhere to one another after they have been blown, and in which vents are provided between the two parts of the preform.

16. A preform according to claim 15, in which the inner part (1) of the preform is made from virgin plastics material and the outer part (4) is made from recycled plastics material.

17. A preform according to claim 1, which comprises one part which forms a basic preform, parts of which are present in the wall of the entire container and a second part which is restricted to a particular localised extent in the complete container.

18. A preform according to claim 17, in which the second part provides localised reinforcement in the form of a ring of a dimensionally stable plastics material which is used to define the inside of the neck of a container and with the remainder of the preform being formed of less stable material.

19. A preform according to claim 17, in which a neck support ring and closure attachment of the preform are formed by a relatively cheap plastics material and the entire inner surface of the neck region and the main body of the preform are formed by a more expensive and less permeable material.

Fig.1

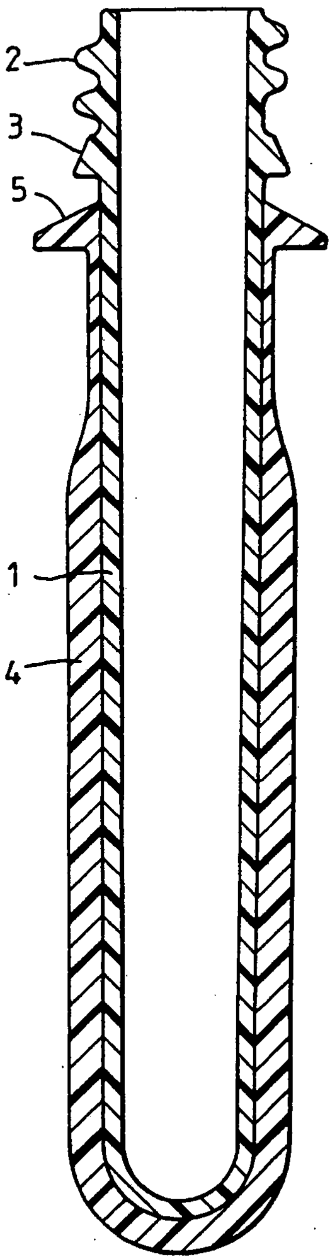


Fig.2

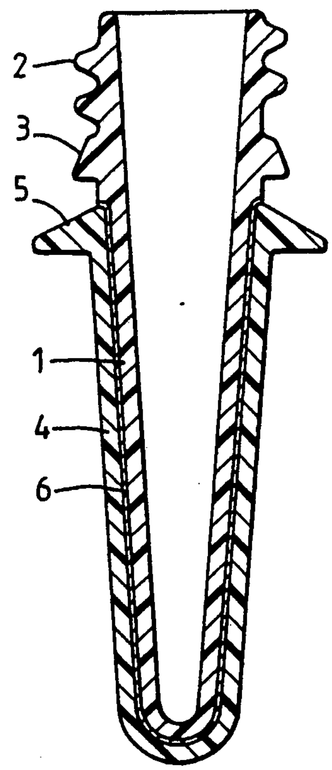


Fig.3

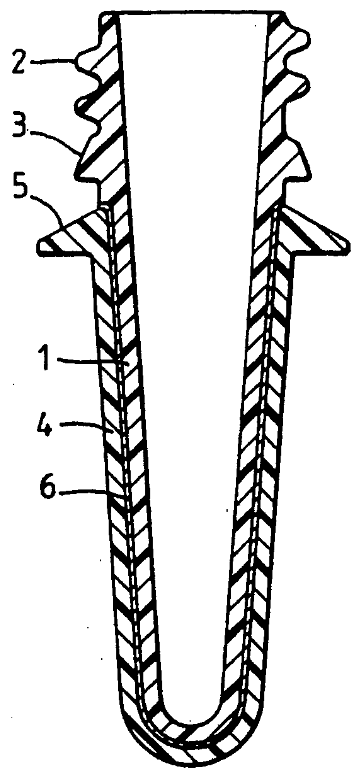


Fig.4

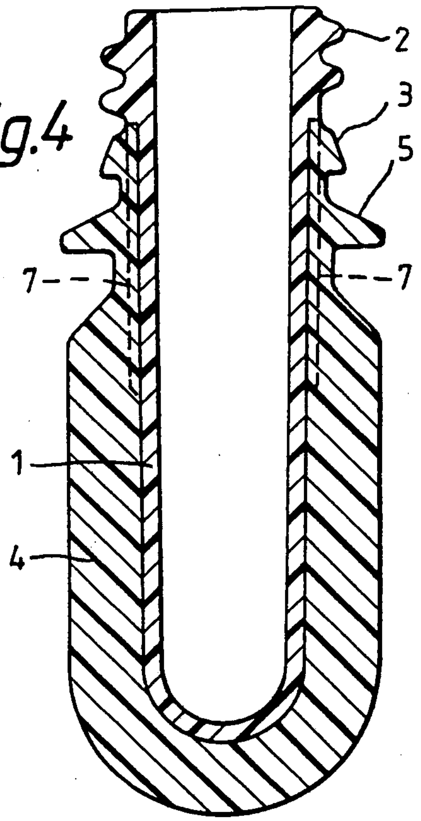


Fig.5

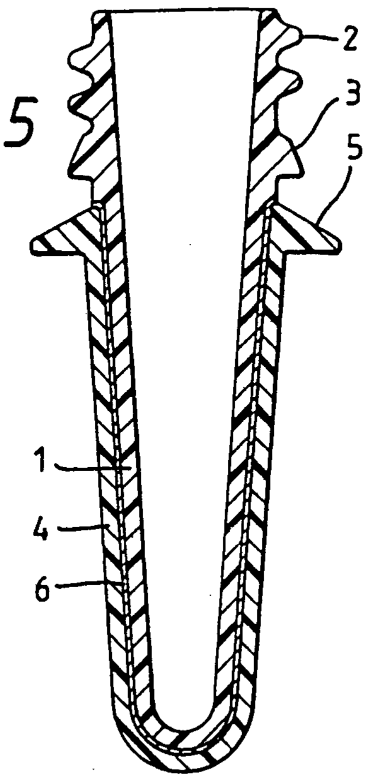


Fig.6

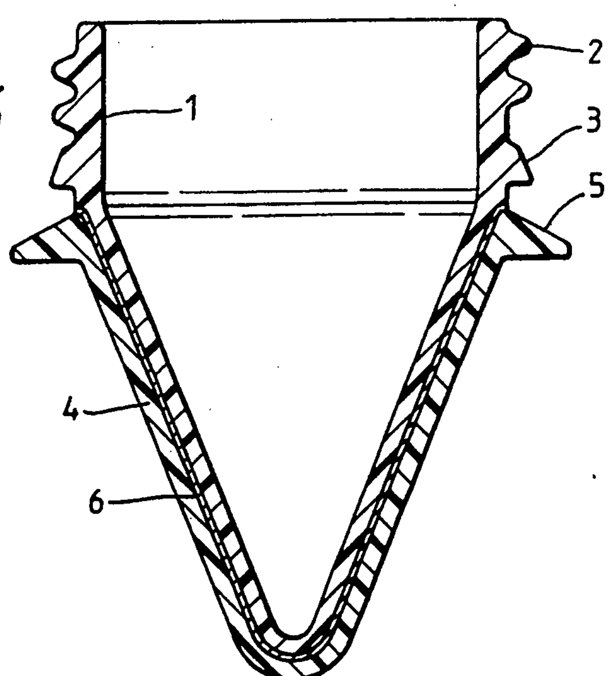


Fig.7

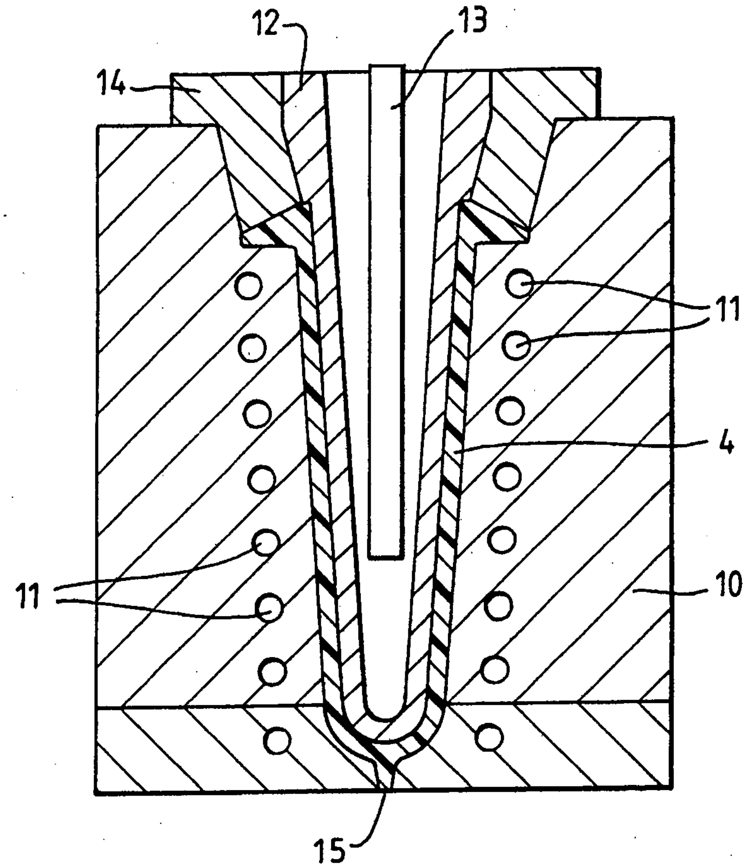


Fig.8

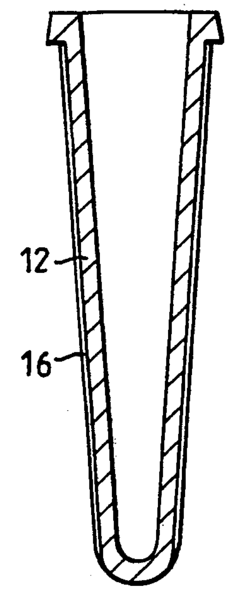


Fig.9

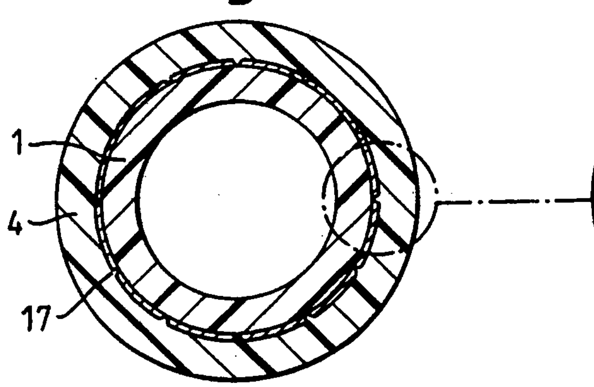
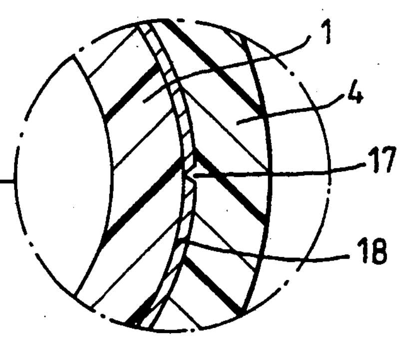


Fig.10



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01812

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC^5: B 29 C 49/22

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC^5	B 29 C, B 29 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [*]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	Research Disclosure, no. 155, March 1977, (Havant, GB), "Laminar preform for blow moulding", Disclosure no. 15520, pages 19,20 see the whole article --	1-5,7,8
X	GB, A, 2076733 (PLM) 9 December 1981 see the whole document --	1-3,5-9
X	Patent Abstracts of Japan, vol. 8, no. 28 (M-274)(1465), 7 February 1984, & JP, A, 58187319 (MITSUBISHI JUSHI K.K.) 1 November 1983 see abstract & figures --	1,2,17-19
X	Patent Abstracts of Japan, vol. 7, no. 20 (M-188)(1165), 26 January 1983 & JP, A, 57174221 (TOUYOU SEIKAN K.K.) 26 October 1982 see abstract & figures	1,2

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1st March 1991	05.04.91
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	N. Toribio Nuria TORIBIO

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9001812
SA 42123

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 25/03/91
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
GB-A- 2076733	09-12-81	SE-B-	429317	29-08-83
		AT-B-	384775	11-01-88
		AT-B-	376168	25-10-84
		AT-B-	386799	10-10-88
		AU-B-	553740	24-07-86
		AU-A-	7118081	03-12-81
		AU-B-	551869	15-05-86
		AU-A-	7118181	03-12-81
		BE-A-	888995	27-11-81
		BE-A-	888996	27-11-81
		BE-A-	888997	27-11-81
		BE-A-	888998	27-11-81
		BE-A-	888999	27-11-81
		CA-A-	1192851	03-09-85
		CA-A-	1204908	27-05-86
		CA-A-	1167616	22-05-84
		CA-A-	1185195	09-04-85
		CA-A-	1181556	29-01-85
		CA-A-	1178761	04-12-84
		CA-C-	1205760	10-06-86
		CA-C-	1204259	13-05-86
		CH-A-	656091	13-06-86
		CH-A-	653607	15-01-86
		CH-A-	653609	15-01-86
		CH-A-	653601	15-01-86
		CH-A-	668742	31-01-89
		DE-A,C	3121420	15-04-82
		DE-A,C	3121421	22-04-82
		DE-A-	3121422	08-04-82
		DE-A,C	3121524	09-06-82
		DE-A,C	3121525	09-06-82
		FR-A,B	2483312	04-12-81
		FR-A,B	2483313	04-12-81
		FR-A,B	2483314	04-12-81
		FR-A,B	2483324	04-12-81
		FR-A,B	2483315	04-12-81
		GB-A,B	2092943	25-08-82
		GB-A,B	2076731	09-12-81
		GB-A,B	2076732	09-12-81

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9001812 SA 42123

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 25/03/91
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 2076733		GB-A,B 2076734	09-12-81
		GB-A,B 2137553	10-10-84
		GB-A,B 2141662	03-01-85
		JP-A,B,C57024219	08-02-82
		JP-A,B,C57034925	25-02-82
		JP-A,B 57020331	02-02-82
		JP-A,B 57020332	02-02-82
		JP-A- 57018222	30-01-82
		NL-A- 8102376	16-12-81
		NL-A- 8102428	16-12-81
		NL-A- 8102556	16-12-81

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☑ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☑ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: ______________________

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.